(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 452 917 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
01.09.2004 Bulletin 2004/36

(21) Application number: **02788695.1**

(22) Date of filing: **29.11.2002**

(51) Int Cl.[7]: **G03F 7/039**, H01L 21/027

(86) International application number:
PCT/JP2002/012524

(87) International publication number:
WO 2003/048861 (12.06.2003 Gazette 2003/24)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.12.2001 JP 2001369341**
14.12.2001 JP 2001382126
10.07.2002 JP 2002201310

(71) Applicant: **TOKYO OHKA KOGYO CO., LTD.**
Kawasaki-shi Kanagawa 211-0012 (JP)

(72) Inventors:
- **Iwai, Takeshi, Tokyo Ohka Kogyo Co., Ltd.**
Kawasaki-shi, Kanagawa 211-0012 (JP)
- **Kubota, Naotaka, Tokyo Ohka Kogyo Co., Ltd.**
Kawasaki-shi, Kanagawa 211-0012 (JP)
- **Fujimura, Satoshi, Tokyo Ohka Kogyo Co., Ltd.**
Kawasaki-shi, Kanagawa 211-0012 (JP)
- **Miyairi, Miwa, Tokyo Ohka Kogyo Co., Ltd.**
Kawasaki-shi, Kanagawa 211-0012 (JP)
- **Hada, Hideo, Tokyo Ohka Kogyo Co., Ltd.**
Kawasaki-shi, Kanagawa 211-0012 (JP)

(74) Representative: **Poulin, Gérard**
BREVALEX
3, rue du Docteur Lancereaux
75008 Paris (FR)

(54) POSITIVE RESIST COMPOSITION AND METHOD OF FORMING RESIST PATTERN FROM THE SAME

(57) There is provided a positive type resin composition comprising (A) a.resin component comprising within the principal chain a structural unit derived from a (meth)acrylate ester and incorporating an acid dissociable, dissolution inhibiting group containing a polycyclic group on an ester side chain section, for which the solubility in alkali increases under the action of acid, (B) an acid generator component which generates acid on exposure, and (C) an organic solvent, wherein the component (A) comprises both a structural unit derived from a methacrylate ester and a structural unit derived from an acrylate ester. According to such a resist composition, a resist pattern can be formed which displays little surface roughness and line edge roughness on etching, and also offers excellent resolution and a wide depth of focus range.

EP 1 452 917 A1

which generates acid on exposure, and (C) an organic solvent (C),

wherein the component (A) comprises both a structural unit derived from a methacrylate ester (hereafter this unit may be abbreviated as a "methacrylate ester structural unit") and a structural unit derived from an acrylate ester (hereafter this unit may be abbreviated as an "acrylate ester structural unit").

[0016] The term "(meth)acrylate" refers to either one, or both of acrylates and methacrylates. Furthermore, the term "structural unit" refers to a monomer unit which contributes to the formation of a polymer.

[0017] A method of forming a resist pattern according to the present invention comprises the steps of applying a positive type resist composition of the present invention to a substrate, conducting a prebake, performing selective exposure, then conducting PEB (post exposure baking), and performing alkali developing to form a resist pattern.

BEST MODE FOR CARRYING OUT THE INVENTION

[0018] As follows is a more detailed description of the present invention.

[0019] In the component (A), the action of the acid generated from the component (B) on exposure causes the aforementioned highly etching resistant, acid dissociable, dissolution inhibiting group containing a polycyclic group to dissociate, and the entire component (A) changes from an alkali insoluble state to an alkali soluble state.

[0020] Consequently, when exposure is conducted through a mask pattern during the formation of a resist pattern, the exposed sections of the composition display a significant increase in solubility relative to alkali, enabling alkali developing to be used.

[0021] In the component (A), the term "comprising both a methacrylate ester structural unit and an acrylate ester structural unit" means that there are no particular restrictions on the form of the component, provided the component (A) incorporates both a methacrylate ester structural unit and an acrylate ester structural unit. For example, the component (A) may be a material comprising a copolymer (A1): a copolymer comprising a methacrylate ester structural unit and an acrylate ester structural unit, or may be a material comprising a mixed resin (A2): a mixed resin of a polymer comprising at least a methacrylate ester structural unit and a polymer comprising at least an acrylate ester structural unit. Either one, or both of the polymers which constitute this mixed resin (A2) may be a copolymer which corresponds with the copolymer (A1).

[0022] Furthermore, other resin components may also be added to the component (A) provided such addition does not impair the effects of the present invention, although in the present invention, a component (A) formed from either one, or both of the aforementioned copolymer (A1) and the aforementioned mixed resin (A2) is preferred.

[0023] In addition, for both the copolymer (A1) and the mixed resin (A2), a combination of two or more different materials can also be used.

[0024] The relative quantities of the methacrylate ester structural unit and the acrylate ester structural unit within the component (A) are such that relative to the combined number of mols of the methacrylate ester structural unit and the acrylate ester structural unit, the methacrylate ester structural unit account for 10 to 85 mol%, and preferably from 20 to 80 mol%, and the acrylate ester structural unit account for 15 to 90 mol% and preferably from 20 to 80 mol%.

[0025] If the quantity of the methacrylate ester structural unit is overly large then the effect in improving the surface roughness is reduced, whereas if the quantity of the acrylate ester structural unit is overly large, there is a danger of a reduction in resolution.

[0026] In addition, the component (A) may also be formed from a combination of a plurality of monomer units with different functions, provided the aforementioned methacrylate ester structural unit and the acrylate ester structural unit are incorporated within one of the monomer units.

[0027] For example, the component (A) can be ideally formed from:

(i) a structural unit derived from a (meth)acrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group (hereafter, also referred to as a first structural unit),

(ii) a structural unit derived from a (meth)acrylate ester, and comprising a lactone containing monocyclic group or polycyclic group (wherein the term "cyclic group" within the expression "monocyclic group or polycyclic group" includes a lactone group) (hereafter, also referred to as a second structural unit), and

(iii) a structural unit derived from a (meth)acrylate ester, and comprising a hydroxyl group containing polycyclic group (hereafter, also referred to as a third structural unit).

In this description and the accompanying claims, the term "lactone containing monocyclic group or polycyclic group" refers to a monocyclic group formed from a lactone ring or a polycyclic group containing a lactone ring. Here, a lactone ring refers to a single ring comprising a -CO-O- structure, and this is counted as the first ring. Accordingly, in the case of a group with only a lactone ring, the name "lactone containing monocyclic group" is used, whereas in the case of a group which also contains other ring structures, the name "lactone containing polycyclic group" is used regardless of the structure of the other rings.

In such a case, the first structural unit is essential, and although combinations of the first structural unit with

[0040] Specific examples include groups in which one hydrogen atom is removed from a polycycloalkane such as adamantane; norbornane, isobornane, tricyclodecane or tetracyclododecane.

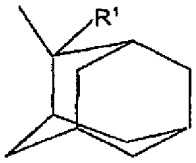
[0041] These types of polycyclic groups can be selected appropriately from the multitude of these types of groups that have been proposed for use with ArF resists.

[0042] Of these groups, adamantyl groups, norbornyl groups and tetracyclododecanyl groups are preferred from an industrial viewpoint.

[0043] Furthermore, there are no particular restrictions on the aforementioned acid dissociable, dissolution inhibiting group, provided that prior to exposure it produces an alkali dissolution inhibiting effect which makes the entire component (A) insoluble in alkali, and following exposure it dissociates through the action of the acid generated from the component (B), converting the entire component (A) to an alkali soluble state.

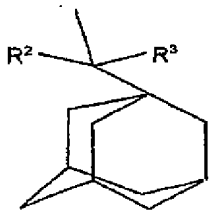
[0044] Typical examples include cyclic or chain type tertiary alkyl esters formed with the carboxyl group of (meth) acrylic acid.

[0045] Provided the structural units (a1), (a1') have the functions described above then there are no particular restrictions on the structural units, although cases in which the acid dissociable, dissolution inhibiting group containing a polycyclic group within either one or both (and preferably both) of the structural units (a1) and (a1') is selected from the general formulas (I), (II) and (III) shown below are preferred, as such units display excellent resolution and dry etching resistance.



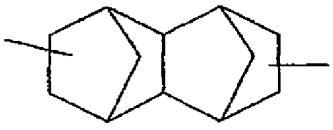
• • • (I)

(wherein, R^1 represents a lower alkyl group)



• • • (II)

(wherein, R^2 and R^3 each represent, independently, a lower alkyl group)



• • • (III)

(wherein, R^4 represents a tertiary alkyl group)

[0046] Specifically, either one or both (and preferably both) of the structural units (a1) and (a1') are preferably at least one type of structural unit selected from the general formulas (I'), (II') and (III') shown below.

increase compared with the case in which R^1 is a methyl group. However in contrast, from an industrial viewpoint, methyl groups are the most desirable.

[0050] The structural unit represented by the general formula (II') represents the case in which the carbon atom adjacent to the oxygen atom (-O-) of a (meth)acrylic acid ester section is a tertiary alkyl group, and a cyclic skeleton such as an adamantyl group exists within this tertiary alkyl group.

[0051] In the general formulas (II) and (II'), R represents the same meaning as in the general formulas (I) and (I').

[0052] Furthermore, R^2 and R^3 each preferably represent, independently, a lower alkyl group of 1 to 5 carbon atoms. These types of groups tend to display a higher acid dissociability than a 2-methyl-2-adamantyl group.

[0053] Specifically, the groups R^2 and R^3 represent, independently, the same types of straight chain or branched alkyl groups described above for R^1. Of these groups, the case in which R^2 and R^3 are both methyl groups is preferred industrially.

[0054] The structural unit represented by the general formula (III') represents the case in which the carbon atom adjacent to the oxygen atom (-O-) of a separate ester section from the (meth)acrylate ester section is a tertiary alkyl group, and the separate ester section and the (meth)aclylate ester section are linked with a cyclic skeleton such as a tetracyclododecanyl group.

[0055] In the general formulas (III) and (III'), R represents the same meaning as in the general formulas (I) and (I').

[0056] Furthermore, R^4 is a tertiary alkyl group such as a tert-butyl group or a tert-amyl group, although structural units in which R^4 is a tert-butyl group are preferred industrially.

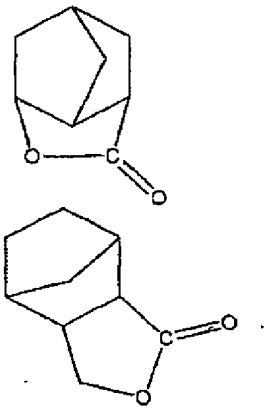
[0057] In particular, the use of either one or both (and preferably both) of the structural units represented by the general formulas (I) and (I)' is preferred, and the case in which R^1 is a methyl group, and R^2 and R^3 are both methyl groups offers particularly good resolution, and is consequently preferred.

[0058] In the structural units (a2) and (a2'), the lactone functional groups are effective in increasing the adhesion between the resist film and a substrate, and in improving the affinity with the developing liquid.

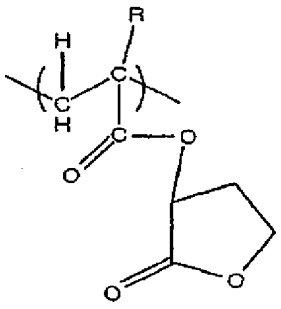
[0059] There are no particular restrictions on the structural units (a2) and (a2'), provided this type of lactone group containing monocyclic group or polycyclic group is present.

[0060] A specific example of a lactone containing monocyclic group is a group in which one hydrogen atom is removed from γ-butyrolactone.

[0061] Furthermore, specific examples of lactone containing polycyclic groups include groups in which one hydrogen atom is removed from a lactone containing bicycloalkane of one of the structural formulas shown below.



[0062] In addition, in either one or both (and preferably both) of the structural unit (a2) and the structural unit (a2'), the lactone containing monocyclic group or polycyclic group is preferably at least one structure selected from the general formulas (IV) or (V) shown below.



(wherein R is as described above)

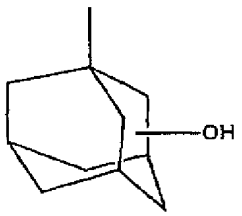
[0064] Of these, γ-butyrolactone esters or norbornane lactone esters of (meth)acrylic acid with an ester linkage at the α carbon atom are particularly preferred in terms of industrial availability.

[0065] Because the hydroxyl group within the structural units (a3) and (a3') is a polar group, by using these structural units, the overall affinity of the resin component (A) with the developing liquid improves, and the alkali solubility within the exposed sections improves. Accordingly, the structural units (a3) and (a3') contribute to improved resolution.

[0066] In the structural units (a3) and (a3'), the polycyclic group can be selected appropriately from the same plurality of polycyclic groups described in relation to the aforementioned structural units (a1) and (a1').

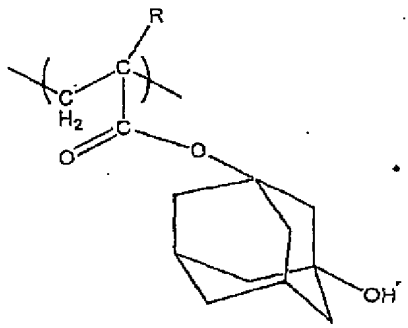
[0067] There are no particular restrictions on these structural units (a3) and (a3') provided they are hydroxyl group containing polycyclic groups, and specific examples of preferred structures include hydroxyl group containing adamantyl groups.

[0068] In addition, if this hydroxyl group containing adamantyl group is of a structure represented by a general formula (VI) shown below, then the dry etching resistance can be improved, and the verticalness of the pattern cross-section can be improved, both of which are desirable.



... (VI)

[0069] Specifically, cases in which either one or both (and preferably both) of the structural units (a3) and (a3') are structural units represented by the general formula (VI') shown below are preferred.



... (VI')

(wherein, R is as described above)

groups of the third structural unit.

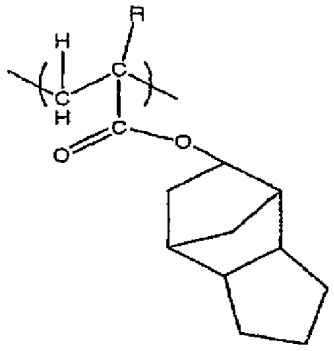
[0089] There are no particular restrictions on this type of polycyclic group, provided that the polycyclic group is selected so that within a single component (A), no duplication occurs of the first through third structural units. For example, the polycyclic group can utilize the same polycyclic groups described above in relation to the structural units (a1) and (a1'), and any of the multitude of materials conventionally used as ArF positive resist materials can be used.

[0090] In particular, at least one polycyclic group selected from among tricyclodecanyl groups, adamantyl groups and tetracyclododecanyl groups is preferred because of the commercial availability of such groups.

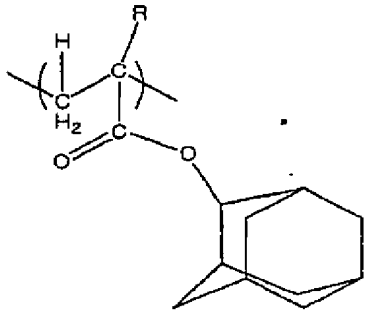
[0091] For the structural unit (a4), a single component (A) may also comprise either one, or both of, a unit derived from an acrylate ester, and a unit derived from a methacrylate ester.

[0092] Specifically, the structural unit (a4) may be one of the structural units used for the copolymer (A1) as described above, or at least one of the structural units of the 1 or more resins which make up the mixed resin (A2), although from the viewpoint of the effects gained, the structural unit (a4) is preferably incorporated as a unit within a copolymer, together with the first though third structural units.

[0093] Specific examples of the structural unit (a4) are shown below.



(wherein, R is a hydrogen atom or a methyl group)



(wherein, R is a hydrogen atom or a methyl group)

quantity exceeds 30 parts by mass, then achieving a uniform solution becomes difficult, and there is a danger of a deterioration in storage stability.

[0108] In addition, a positive type resist composition of the present invention is produced by dissolving the component (A), the component (B) and an optional component (D), which is described below, preferably in an organic solvent (C).

[0109] The organic solvent (C) can be any solvent capable of dissolving the component (A) and the component (B) to generate a uniform solution, and the solvent used can be one, or two or more solvents selected from amongst known solvents used for conventional chemically amplified resists.

[0110] Examples of the solvent include ketones such as acetone, methyl ethyl ketone, cyclohexanone, methyl isoamyl ketone and 2-heptanone; polyhydric alcohols and derivatives thereof such as ethylene glycol, ethylene glycol monoacetate, diethylene glycol, diethylene glycol monoacetate, propylene glycol, propylene glycol monoacetate, dipropylene glycol, or the monomethyl ether, monoethyl ether, monopropyl ether, monobutyl ether or monophenyl ether of dipropylene glycol monoacetate; cyclic ethers such as dioxane; and esters such as methyl lactate, ethyl lactate, methyl acetate, ethyl acetate, butyl acetate, methyl pyruvate, ethyl pyruvate, methyl methoxypropionate, and ethyl ethoxypropionate. These organic solvents can be used singularly, or as a mixed solvent of two or more solvents.

[0111] In particular, mixed solvents of propylene glycol monomethyl ether acetate (PGMEA) and a polar solvent containing a hydroxyl group or lactone such as propylene glycol monomethyl ether (PGME), ethyl lactate (EL) or γ-butyrolactone offer good improvement in the storage stability of the positive type resin composition, and are consequently preferred.

[0112] In those cases in which EL is used, the mass ratio of PGMEA:EL is preferably within a range from 6:4 to 4:6.

[0113] In those cases in which PGME is used, the mass ratio of PGMEA:PGME is typically within a range from 8:2 to 2:8, and preferably from 8:2 to 5:5.

[0114] Mixed solvents of PGMEA and PGME improve the storage stability in those cases in which a component (A) which comprises all of the first through fourth structural units is used, and are consequently preferred.

[0115] Mixed solvents containing at least one of PGMEA and ethyl lactate, together with γ-butyrolactone are also preferred as the organic solvent (C). In such cases, the mass ratio of the former and latter components in the mixed solvent is preferably within a range from 70:30 to 95:5.

[0116] Furthermore, in a positive type resist composition of the present invention, in order to improve the resist pattern shape and the post exposure stability of the latent image formed by the pattern-wise exposure of the resist layer, a secondary lower aliphatic amine or a tertiary lower aliphatic amine (D) can also be added as an optional component (D).

[0117] Here, a lower aliphatic amine refers to an alkyl amine or an alkyl alcohol amine of no more than 5 carbon atoms, and examples of these secondary and tertiary amines include trimethylamine, diethylamine, triethylamine, di-n-propylamine, tri-n-propylamine, tripentylamine, diethanolamine and triethanolamine, and alkanolamines such as triethanolamine are preferred.

[0118] These may be used singularly, or in combinations of two or more compounds.

[0119] These types of amines are typically added in quantities within a range from 0.01 to 0.2 mass% relative to the quantity of the component (A).

[0120] Miscible additives can also be added to a positive type resist composition of the present invention according to need, including additive resins for improving the properties of the resist film, surfactants for improving the ease of application, dissolution inhibitors, plasticizers, stabilizers, colorants and halation prevention agents.

[0121] A pattern formation method of the present invention can be conducted, for example, in the manner described below.

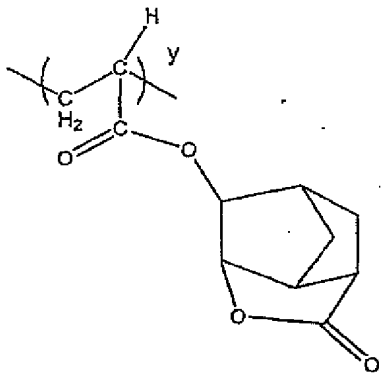
[0122] Namely, a positive type resist composition of the present invention is first applied to the surface of a substrate such as a silicon wafer using a spinner or the like, a prebake is conducted under temperature conditions of 80 to 150°C for 40 to 120 seconds, and preferably for 60 to 90 seconds, and then following selective exposure of an ArF excimer laser through a desired mask pattern using, for example, an ArF exposure apparatus, PEB (post exposure baking) is conducted under temperature conditions of 80 to 150°C for 40 to 120 seconds, and preferably for 60 to 90 seconds. Subsequently, developing is conducted using an alkali developing liquid such as a 0.1 to 10 mass% aqueous solution of tetramethylammonium hydroxide. In this manner, a resist pattern which is faithful to the mask pattern can be obtained.

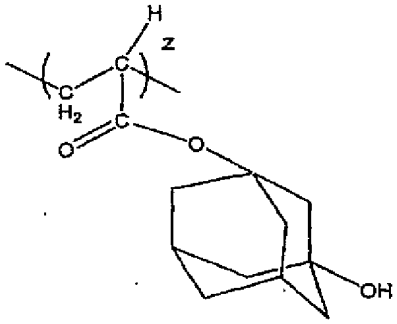
[0123] An organic or inorganic anti-reflective film may also be provided between the substrate and the applied layer of the resist composition.

[0124] Furthermore, although a composition of the present invention is particularly applicable to ArF excimer lasers, it is also effective for other types of radiation of shorter wavelength such as F_2 lasers, EUV (extreme ultraviolet radiation), VUV (vacuum ultraviolet radiation), electron beams, X-rays and soft X-rays.

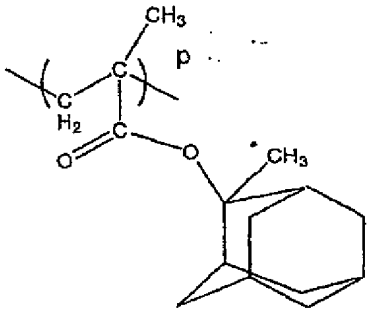
[0125] In the present invention, by using this type of configuration, a chemically amplified positive type resist composition which displays little surface roughness or line edge roughness on etching, and also offers excellent resolution and a wide depth of focus range can be obtained.

[0126] The reasons for these effects are not entirely clear, but are believed to be as follows.





and 50 parts by mass of a methacrylate ester based copolymer (mass average molecular weight: 10,000) formed from structural units p, q and l shown below (p = 40 mol%, q = 40 mol%, l = 20 mol%).



Pressure: 0.3 Torr
RF (Radio frequency): Frequency: 400 kHz, output: 600 W
Temperature: 20°C, time: 2 minutes
Etching apparatus: TCE-7612X (a brand name, manufactured by Tokyo Ohka Kogyo Co., Ltd.)

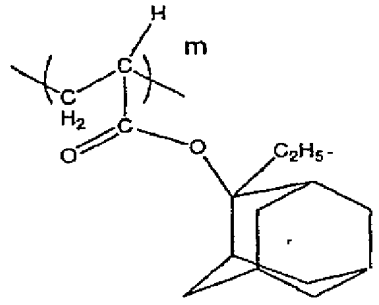
The reason for performing the evaluation using an unpatterned resist film is that this enables surface roughness to be measured more easily.

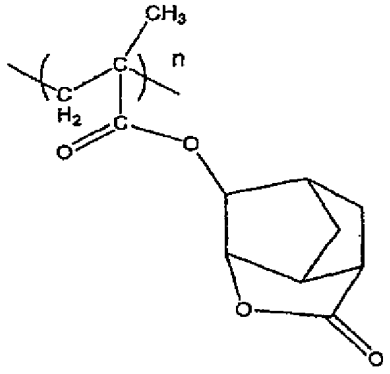
The surface following this etching was numericalized with an AFM (Atomic Force Microscope), and when the Rms value (root mean square surface roughness), which is a value representing the surface roughness, was then determined, the result was 2.5 nm.

Example 2

[0142] With the exception of altering the component (A) in the manner described below, a positive type resist composition was prepared, and pattern formation was conducted, in the same manner as Example 1.

- Component (A): A mixed resin comprising a polymer (mass average molecular weight: 15,000) in which the structural units y and z within the acrylate ester based copolymer used in Example 1 were altered to 50 mol% and 20 mol% respectively, and the structural unit x was replaced with 30 mol% of a structural unit m shown below, and a polymer (mass average molecular weight: 10,000) in which the structural unit q within the methacrylate ester based copolymer used in Example 1 was replaced with a structural unit n shown below. The proportions of the structural units p, n and l were the same as the proportions of the structural units p, q and l respectively used in Example 1.





[0143] As a result, a 130 nm line and space pattern (1:1) was formed with good shape, and the depth of focus range was 700 nm. Furthermore, determination of the 3σ value revealed a result of 5.8 nm.

[0144] Inspection for defects was also conducted in the same manner as Example 1, and revealed 0 defects.

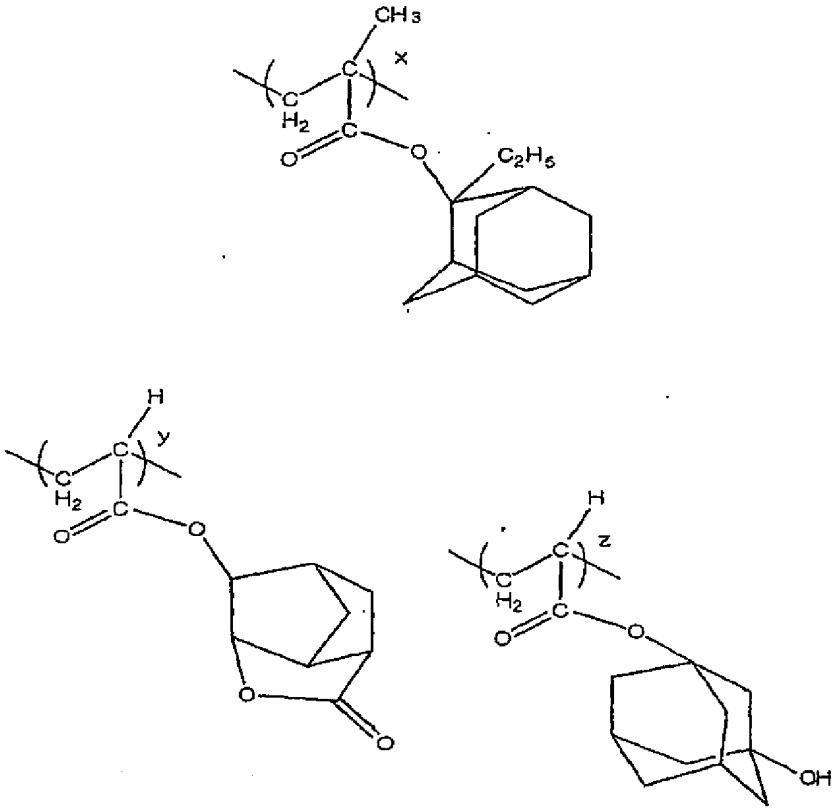
of the line and space pattern was good, the depth of focus range was large, line edge roughness was minimal, and absolutely no defects were observed.

In contrast, in Comparative Example 1 which used a base resin formed from only methacrylate ester structural units, line edge roughness and surface roughness were large, whereas in Comparative Example 2 which used a base resin formed from only acrylate ester structural units, the depth of focus range was small and a multitude of defects were observed.

Example 5

[0150] A positive type resist composition was produced by dissolving a component (A), a component (B), a component (D) and an additive uniformly in a component (C), all of which are described below.

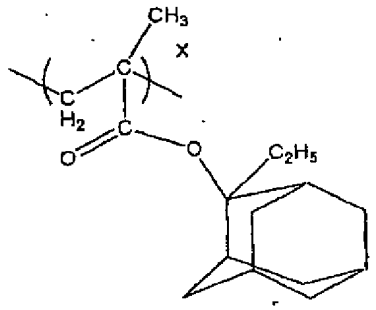
- Component (A): 100 parts by mass of an acrylate ester / methacrylate ester copolymer (mass average molecular weight: 10,000, polydispersity: 1.80) formed from structural units x, y, z and p shown below (x = 35 mol%, y = 40 mol%, z = 15 mol%, p = 10 mol%).

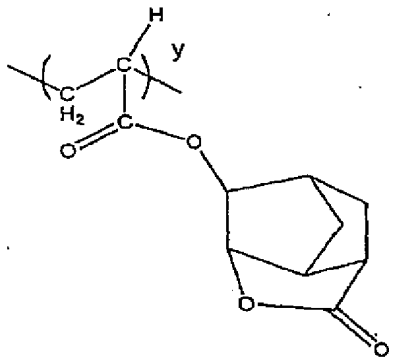


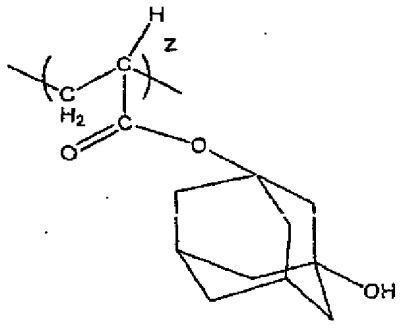
Example 7

[0155] A positive type resist composition was produced by dissolving a component (A), a component (B), a component (D) and an additive uniformly in a component (C), all of which are described below.

- Component (A): 100 parts by mass of an acrylate ester / methacrylate ester copolymer (mass average molecular weight: 11,000, polydispersity: 1.9) formed from the structural units shown below (x = 30 mol%, y = 50 mol%, z = 20 mol%).







- Component (B): 3.5 parts by mass of (p-methylphenyl)diphenylsulfonium nonafluorobutanesulfonate
- Component (C): A mixed solvent of 450 parts by mass of propylene glycol monomethyl ether acetate (PGMEA), 300 parts by mass of propylene glycol monomethyl ether (PGME), and 25 parts by mass of γ-butyrolactone.
- Component (D): 0.3 parts by mass of triethanolamine.

acid, (B) an acid generator component which generates acid on exposure, and (C) an organic solvent (C), wherein said component (A) comprises both a structural unit derived from a methacrylate ester and a structural unit derived from an acrylate ester.

2. A positive type resist composition according to claim 1, wherein said component (A) comprises a copolymer (A1) with a structural unit derived from a methacrylate ester and a structural unit derived from an acrylate ester.

3. A positive type resist composition according to claim 1, wherein said component (A) comprises a mixed resin (A2) of a polymer comprising at least a structural unit derived from a methacrylate ester, and a polymer comprising at least a structural unit derived from an acrylate ester.

4. A positive type resist composition according to claim 1, wherein said component (A) comprises
a structural unit derived from a (meth)acrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group,
a structural unit derived from a (meth)acrylate ester, and comprising a lactone containing monocyclic group or polycyclic group , and
a structural unit derived from a (meth)acrylate ester, and comprising a hydroxyl group containing polycyclic group.

5. A positive type resist composition according to claim 4, wherein said component (A) comprises either one, or both of:

a structural unit (a1) derived from an acrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, and
a structural unit (a1') derived from a methacrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group.

6. A positive type resist composition according to claim 4, wherein said component (A) comprises either one, or both of:

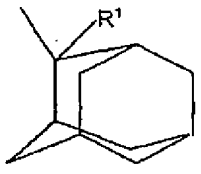
a structural unit (a2) derived from an acrylate ester, and comprising a lactone containing monocyclic group or polycyclic group, and
a structural unit (a2') derived from a methacrylate ester, and comprising a lactone containing monocyclic group or polycyclic group.

7. A positive type resist composition according to claim 4, wherein said component (A) comprises either one, or both of:

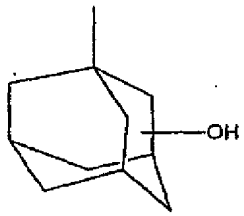
a structural unit (a3) derived from an acrylate ester, and comprising a hydroxyl group containing polycyclic group, and
a structural unit (a3') derived from a methacrylate ester, and comprising a hydroxyl group containing polycyclic group.

8. A positive type resist composition according to claim 5, wherein within either one or both of said structural unit (a1) and said structural unit (a1'):

said acid dissociable, dissolution inhibiting group containing a polycyclic group is at least one group selected from general formulas (I), (II) and (III) shown below:



... (I)



... (VI)

12. A positive type resist composition according to claim 5, wherein
relative to a combined total of all structural units which make up said component (A), a combined total of said structural unit (a1) and said structural unit (a1') accounts for 30 to 60 mol%.

13. A positive type resist composition according to claim 6, wherein
relative to a combined total of all structural units which make up said component (A), a combined total of said structural unit (a2) and said structural unit (a2') accounts for 20 to 60 mol%.

14. A positive type resist composition according to claim 7, wherein
relative to a combined total of all structural units which make up said component (A), a combined total of said structural unit (a3) and said structural unit (a3') accounts for 1 to 50 mol%.

15. A positive type resist composition according to claim 2, wherein said copolymer (A1) is a copolymer (a) described below:

copolymer (a): a copolymer formed from 30 to 60 mol% of a structural unit (a1') derived from a methacrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, 20 to 60 mol% of a structural unit (a2') derived from a methacrylate ester, and comprising a lactone containing monocyclic group or polycyclic group , and 1 to 50 mol% of a structural unit (a3) derived from an acrylate ester, and comprising a hydroxyl group containing polycyclic group.

16. A positive type resist composition according to claim 3, wherein
said mixed resin (A2) is a mixed resin of a copolymer (b) and a copolymer (c) described below:

copolymer (b): a copolymer formed from 30 to 60 mol% of a structural unit (a1) derived from an acrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, 20 to 60 mol% of a structural unit (a2) derived from an acrylate ester, and comprising a lactone containing monocyclic group or polycyclic group, and 1 to 50 mol% of a structural unit (a3) derived from an acrylate ester, and comprising a hydroxyl group containing polycyclic group,
copolymer (c): a copolymer formed from 30 to 60 mol% of a structural unit (a1') derived from a methacrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, 20 to 60 mol% of a structural unit (a2') derived from a methacrylate ester, and comprising a lactone containing monocyclic group or polycyclic group , and 1 to 50 mol% of a structural unit (a3') derived from a methacrylate ester, and comprising a hydroxyl group containing polycyclic group.

17. A positive type resist composition according to claim 3, wherein
said mixed resin (A2) is a mixed resin of a copolymer (a) and a copolymer (b) described below:

copolymer (a): a copolymer formed from 30 to 60 mol% of a structural unit (a1') derived from a methacrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, 20 to 60 mol% of a structural unit (a2') derived from a methacrylate ester, and comprising a lactone containing monocyclic group or polycyclic group , and 1 to 50 mol% of a structural unit (a3) derived from an acrylate ester, and comprising a hydroxyl group containing polycyclic group,
copolymer (b): a copolymer formed from 30 to 60 mol% of a structural unit (a1) derived from an acrylate ester, and comprising an acid dissociable, dissolution inhibiting group containing a polycyclic group, 20 to 60 mol% of a structural unit (a2) derived from an acrylate ester, and comprising a lactone containing monocyclic group or polycyclic group , and 1 to 50 mol% of a structural unit (a3) derived from an acrylate ester, and comprising

26. A positive type resist composition according to claim 25, wherein said polar solvent is one, or two or more solvents selected from a group consisting of propylene glycol monomethyl ether, ethyl lactate and γ-butyrolactone.

27. A positive type resist composition according to claim 1, further comprising (D) a secondary or tertiary lower aliphatic amine in a quantity within a range from 0.01 to 0.2 mass% relative to a quantity of said component (A).

28. A method of forming a resist pattern comprising the steps of applying a positive type resist composition according to any one of claim 1 through claim 27 to a substrate, conducting a prebake, performing selective exposure, conducting post exposure baking, and performing alkali developing to form a resist pattern.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/12524

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2001-188347 A (JSR Corp.), 10 July, 2001 (10.07.01), Par. Nos. [0147] to [0148], [0103] to [0120] (Family: none)	1-2,4-14, 24-28 15,18 3,16,17, 19-23

Form PCT/ISA/210 (continuation of second sheet) (July 1998)